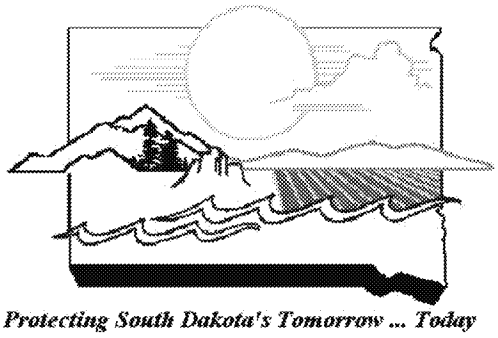
South Dakota Department of Environment and Natural Resources

Water Quality Monitoring Strategy



2017-2027

TABLE OF CONTENTS

Introduction

Water Resources:
South Dakota has extensive water resources including 9,726 miles of perennial rivers and streams, 576 lakes and reservoirs as well as an estimated 1.87 million acres of wetlands. All of these features represent resources important to South Dakota and its citizens, and it is the goal of the South Dakota Department of Environment and Natural Resources (DENR) to restore and protect these waters for current and future uses.

Regulatory Framework:
The South Dakota Committee on Water Pollution in 1967, first established water quality standards for all surface waters. By 1972, municipal and industrial wastewater pollution of the rivers, streams, and lakes in America had become a national concern. To clean up the nation's waters, Congress passed the federal Clean Water Act of 1972. One of the requirements of the Clean Water Act was for states to develop standards for their waters to ensure the protection of beneficial uses such as swimming and fishing. Under the South Dakota Clean Water Law (South Dakota Codified Laws Chapter 34A-2), pollution of the waters of this state constitutes a menace to public health and welfare; creates public nuisances; is harmful to wildlife, fish, and aquatic life; and impairs domestic, agricultural, industrial, recreational, and other legitimate beneficial uses of water. For this reason, it is the goal of DENR to conserve the waters of the state and to protect, maintain, and improve the quality thereof. To this end, rules and regulations have been established to assure that waste is not discharged to waters of the state without first receiving adequate treatment.

I. Monitoring Program Strategy

The mission of DENR is to provide environmental and natural resources assessment, financial assistance, and regulation in a customer service oriented manner which provides protection of public health, conservation of natural resources, preservation of the environment, and promotes economic development. Two organizational divisions with DENR carry out this mission. The Division of Financial and Technical Assistance provides funding for the assessment and control of point and nonpoint source pollution through the federal revolving loan funds and Section 319 Clean Water Act grants and state general funds. The Division also provides technical assistance through the Watershed and Geological Survey Programs.

The Division of Environmental Services is the regulatory division of DENR. Through the Drinking Water, Minerals and Mining, Water Rights, Air Quality, Ground Water Quality, Solid Waste Management, and Surface Water Quality Programs, the Division implements state and federal environmental regulations.

To carry out the department's mission, both divisions have water quality monitoring responsibilities and have developed the Water Quality Monitoring Strategy. DENR's Water Quality Monitoring Strategy is a long-term monitoring approach that addresses water quality management needs and covers all waters of the state. The water quality goals of the state are to: identify water quality problems, set forth effective management programs for water pollution control, alleviate water quality problems, and achieve and preserve water quality for all intended

uses. The monitoring program is flexible, efficient, and provides information that can meet the state's monitoring objectives.

South Dakota DENR monitors waters in the state through an established ambient water quality sampling program, water quality surveys, fish surveys, total maximum daily loads (TMDL) assessments, Surface Water Discharge permits, state nonpoint source implementation projects and other special monitoring projects such as: biological integrity monitoring, recreational use surveys, probabilistic lake survey designs, nutrient impact studies, reference condition studies, participation in EPA's National Aquatic Resource Surveys, etc. Aside from DENR, the United States Geological Survey (USGS) also conducts routine monitoring throughout the state. All data resulting from USGS monitoring efforts are available from the USGS website. Much of the state's data has been entered into the United States Environmental Protection Agency's Water Quality Exchange (WQX) database.

The following are the key priorities for the State of South Dakota and U.S. Environmental Protection Agency Multi-Year Agreement (Performance Partnership Agreement) for federal fiscal years relating to the department's Water Quality Monitoring Strategy:

- Continued development and refinement of Surface Water Quality Standards
- Continued development and refinement of monitoring programs and approaches
- Statewide Ground Water Quality Monitoring Network
- Implementation of EPA's Vision Strategy (including TMDL Prioritization)
- Assessment of all state waters

II. Monitoring Objectives

To carry out these priorities, DENR currently uses various monitoring designs and has identified the following needs and timelines:

The surface water quality objectives of the South Dakota Department of Environment and Natural Resources include, but are not limited to, the basic objectives of the Clean Water Act. These include:

- Establishing, reviewing, and revising water quality standards;
- Determining water quality standards attainment;
- Identifying impaired waters;
- Identifying causes and sources of water quality impairments;
- Evaluating effectiveness of watershed plans and other approaches designed to improve and protect water quality;
- Supporting the evaluation of program effectiveness; and
- Collecting monitoring data to support Surface Water Discharge permitting and compliance.

As a result of successfully meeting these objectives, DENR is to answer the following questions:

1. What is the overall water quality of waters in the state?
2. To what extent is water quality changing over time?
3. What are the problem areas and areas needing protection?
4. What level of protection is needed?
5. How effective are the clean water projects and programs?
6. Are there new water quality challenges in SD which need to be addressed?

Table 1. South Dakota DENR Water Quality Monitoring Objectives

Program Area	Objectives
Fixed Station Ambient Monitoring Network	Develop surface water discharge permits, develop point source TMDLs, support enforcement decisions, evaluate effectiveness of permits, analyze trends, determine water quality standards attainment, and identify impaired waters. (Sections 402, 303(d), 305(b)) Determine restoration status.
Intensive Sampling	Establish, review, and revise water quality standards, intensive special studies for new criteria (e.g. nutrients, biological condition, sedimentation/physical habitat, E. coli), develop site-specific criteria, develop endpoints for TMDLs, conduct beneficial use surveys, and antidegradation determination. (Sections 303(c), 303(d),305(b))
TMDL/Nonpoint Source Program Monitoring (Including Implementation of EPA's Vision Strategy)	Determine water quality standards attainment, identify impaired waters, identify causes and sources of water quality impairments, prioritize and develop TMDLs, conduct watershed assessments, evaluate effectiveness of watershed plans, and monitor and assess biological conditions. (Sections 305(b), 303(d), 319, 303(c))
Lake Water Quality Assessment Program	Assess condition of lakes and reservoirs, determine water quality standards attainment, identify causes and sources of impairment, develop TMDLs, evaluate the effectiveness of pollution controls, and revise water quality standards, (Sections 314, 305(b), 303(d), 303(c))
Reference Site Network (lakes, rivers & streams)	Provide evidence of impairment for site specific standards or for biological data.
Missouri River Assessment Still valid?	Continue to monitor water quality status of the Missouri River Reservoirs in South Dakota. (Sections 303(d), 305(b), 314, 319)
Wetlands Still valid?	Understand water quality status, develop surface water quality discharge permits,

Commented [RL1]: Is the Missouri River still a monitoring objective?

Commented [RL2]: DENRs data on wetlands is at least 7 years old. Are there plans to focus on updating wetlands data in the future? Is this still a monitoring objective?

	support enforcement decision, and evaluate effectiveness of permits.
Ground Water	Examine sensitive aquifers or those aquifers that are likely to be impacted by human activities because of their near-surface occurrence combined with overlying land-use practices.
Biological Integrity Monitoring	Continue to collect biological samples to support a variety of efforts including development of UAAs, assess health of lakes and streams, and continued development of a state biological reference collection and database.
Nutrient Impact Studies	Development of Nutrient-Related Narrative Standards

Fixed Station Ambient Monitoring Network

The DENR maintains a fixed station ambient monitoring network of 132 stations (as of 2016). Sites represent both wadeable and nonwadeable streams and rivers. All 132 sites are sampled each year, and samples are collected on a monthly, quarterly, or seasonal basis.

The fixed station network provides state-wide spatial and temporal coverage, and the data are used for multiple decision needs such as permit development, TMDLs, trends, antidegradation, and in the development of the biennial Integrated Report. These fixed stations are located within high quality beneficial use classifications (waters that fully support their beneficial uses), above and below municipal/industrial discharges, and within problem watersheds. These data are used to characterize historical information, natural background conditions, runoff events, and acute and chronic water quality problems.

Grab samples are collected mid-stream either from a bridge or by wading. Some samples are collected from the bank depending on stream conditions. When the sample has been collected, the sampler immediately obtains water and air temperatures, pH, and dissolved oxygen measurements. Time and date of sample, water depth, channel width and other visual observations are recorded. The samples are preserved and transported to a laboratory for analysis. Samples are routinely analyzed for E.coli, conductivity, hardness, BOD_5 , alkalinity, total solids, total suspended solids, pH, ammonia, nitrates, and total phosphorus. Several stations are sampled for sodium, magnesium and calcium. Stations that are located in streams that receive flows associated with hard rock mines are also monitored for cyanide, cadmium, lead, copper, zinc, chromium, mercury, nickel, silver, and arsenic. Stations along streams that receive flows from historic uranium mining or current exploration are analyzed for arsenic, barium, molybdenum, uranium, radium 226, and radium 228.

Please see the attached list of ambient water quality monitoring stations and the water quality parameters that are collected.

Intensive Sampling

Intensive monitoring is also used to document stream improvement areas, stream degradation areas, develop point source TMDLs, or provide data for developing or verifying Surface Water Discharge permit limits. Intensive surveys are sometimes initiated to assess special problem areas, to obtain data for use in site-specific criteria modification studies, or to provide an updated water quality status for a waterbody.

Major wastewater facilities needing greater than secondary treatment are evaluated by conducting an intensive water quality survey both above and below their wastewater discharge location. These wasteload allocations are the basis for future treatment needs and Surface Water Discharge permits. After wastewater treatment facilities are upgraded, monitoring data is used to verify permit limits developed through computer modeling. With increased emphasis on water quality monitoring improvements to justify federal expenditures, this monitoring program will concentrate on showing water quality improvements from the upgrading of wastewater treatment facilities.

TMDL/Nonpoint Source Program Monitoring (for rivers/streams)

During a TMDL assessment, monitoring stations are set up to target areas of the watershed that may be having an impact on the impaired water body. Monitoring stations are installed with a stage recorder set to record stages every 15 minutes. The 15 minutes stages are then averaged into a daily average. Discharge measurements are collected at all sites at different stages to develop stage discharge relationship. The stage discharge relationships are then used in conjunction with concentration data to develop daily loads.

Commented [RL3]: Is this still accurate?

Samples are collected from spring thaw to winter freeze. Base flow and event samples are collected during each season. The data is organized and analyzed using the US Corp of Engineer's FLUX model or the HSPF model. Typically a general suite of parameters include the parameter of concern along with nutrient, solids and bacteria. The TMDL assessment projects usually last 1 to 3 years.

Commented [RL4]: Is this still correct?

TMDL segments in South Dakota are typically included as part of a watershed study on the entire basin encompassing the impaired listed area in the Integrated Report. When addressing specific TMDLs the department looks at a variety of parameters to determine sources of impairment and to determine if other parameters may need a TMDL. The parameter list may include nutrients, solids, and bacterial information. Biological (macroinvertebrate) and habitat information are also collected at many of the sites. Each site is gauged for water height and stage discharge relationships are developed over the project period. The stage discharge information is used to help calculate loads and reductions needed for the TMDL. The AnnAGNPS or the HSPF models are used to determine sediment and nutrient inputs from sheet and rill erosion. Estimation of bed and bank erosion is calculated by methods used by Rosgen and also the ARS sedimentation lab (Simon).

Commented [RL5]: Is this still correct?

The models predict what can be improved in the watershed. Reasonable targets are set based on the models. The percent reduction calculated from the models is applied to the water quality monitoring to determine if water quality standards can be met. The TMDLs are based on the modeled reductions.

Recognizing that all watersheds are different, sites are typically selected by their potential to assist in targeting subwatersheds that may be sources of the impairments. Subwatershed sites coincide with the AnnAGNPS model to check for relative accuracy of the model. Monitoring plans also utilize USGS Gauging data where available.

All information collected is added to the States SQL database where it is verified and uploaded into STORET/WQX. The SQL database is the department's standalone database for biological, physical and chemical data from the Surface Water Quality Program, Watershed Protection Program and in the future a repository for data from the Ground Water Program. The database will be used to organize and upload data into EPA's Water Quality Data Exchange.

Commented [RL6]: Is this still the case?

South Dakota's Long-Term Strategy (as part of EPA's Vision Strategy) efforts look to Section 303(d) of the CWA as an opportunity to more effectively restore and protect South Dakota's waters. This is accomplished through a systematic process of prioritizing TMDL development and implementation of alternative approaches and protection activities. A Long-Term "Vision" has been developed by EPA, and six actions have been identified as being important to this process (Engagement, Prioritization, Protection, Integration, Alternatives, Assessment). For more information on South Dakota's Long-Term Strategy see page 18 of DENR's 2016 Integrated Report.

Lake Water Quality Assessment Program

There are 576 lakes and reservoirs in South Dakota. Assessment prioritization is based on lakes having recreation opportunities and/or a variety of fish species present, or are deemed publically important for other reasons. For the 2016 Integrated Report, DENR reported that 172 of these lakes had been assessed which represents 67% of total lake acreage. DENR continues to utilize a random lake survey design. This design allows DENR to sample a sub-set (minimum of 50 lakes) of the most important water resources in the state, while the random component provides statistically valid results to make general determinations about the entire lake population. The n umber of lakes sampled annually is dependent on available resources and statistical requirements of the random sampling component.

A suite of water quality parameters is collected during standard assessment efforts. These include chemical, physical and biological indicators. DENR also continues to implement their lake assessment methodology for nutrient-related narrative standards. This new approach evaluates lakes with a multiple lines of evidence approach, to determine if nutrient impacts are present.

DENR will also conduct in-depth studies on a sub-set of lakes if needed. These studies can be driven by a variety of needs and priorities.

All information collected is added to the state's SQL database where it is verified and then uploaded into WQX/STORET. The information is used to determine long-term trends and also for determination of acres assessed and impairment for the bi-annual Integrated Report. See SD's 2016 Integrated Report for more information on lake sampling and assessment efforts.

Reference Site Network and Reference Conditions

South Dakota is aware of the need for a reference site network when developing site specific standards or when using biology for determining the condition of surface waters. Current efforts

in the area include establishing a biological reference collection and database. DENR and Gane, Fish & Parks (GF&P) are providing financial and technical support for the development of a statewide biological reference collection and database. Development and maintenance are being conducted by the Natural Resource Management Department at SDSU. All information associated with each specimen is document in the SPECIFY database. SD GF&P along with SDSU recently began implementing a statewide stream mussel, macroinvertebrate and fish survey. The stream site sampling locations selected for the survey are based on areas that are poorly represented according to the SPECIFY system. The long term goal of the project is to make biological information available to a variety of users.

Missouri River

Long term ambient fixed site sampling of the Missouri River consists of sampling sites located at the powerhouses of the four dams sited on the river. In 2005, DENR initiated a project to sample the lower three reservoirs (Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake). This sampling was developed in close cooperation with the EPA Duluth Lab. The sampling includes the use of probability design and closely follows EPA's previous sampling efforts on the upper Missouri River Reservoirs. DENR continues to monitor water quality of the Missouri River.

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Wetlands

In 1992, the South Dakota Department of Agriculture, Department of Environment and Natural Resources, Department of Game, Fish and Parks, and the Department of Transportation entered into a Memorandum of Understanding (MOU). Under this MOU, the Department of Agriculture (DOA) agreed to administer the state's wetland program. Although the MOU is no longer in effect, the three state natural resource agencies have chosen DOA to take the lead on wetlands issues.

South Dakota has an estimated 1.78 million acres of small depressional wetlands with shallow water habitat. Because of this, South Dakota Surface Water Quality Standards contain provisions to include wetlands as "waters of the state." Wetlands are assigned the beneficial use of fish and wildlife propagation, recreation and stock watering, which provides protection under existing narrative and numeric water quality standards.

North Dakota State University (NDSU) conducted research focused on assessing the ecological health of wetland resources within the prairie pothole region of the eastern Dakotas. Preliminary implications of this study suggest that the ecological health of eastern South Dakota prairie pothole wetlands decrease from north to south. This was attributed to greater agricultural intensity in southeast South Dakota (Dekeyser, personal communication).

South Dakota State University in cooperation with the South Dakota Department of Game, Fish, and Parks is also in the beginning stages of developing a wetland rapid assessment protocol for eastern South Dakota. The South Dakota wetland rapid assessment protocol will be used by the State's Natural Heritage and Wildlife Habitat Programs (South Dakota Game Fish and Parks) for identifying reference wetlands, monitoring randomly selected sites, and evaluating wetland restoration efforts.

Commented [RL8]: Do you know if newer studies have been conducted? If so, is more recent data available to include I the IRs and Monitoring Strategy?

Ground Water

The Statewide Ground Water Quality Monitoring Network was established to examine sensitive aquifers, or those aquifers that are likely to be impacted by human activities because of their near-surface occurrence combined with overlying land-use practices. The design of the monitoring network allows an understanding of water quality to be developed for a large geographic area that includes differing climatic conditions, geologic conditions, and land-use practices. This monitoring network allows the evaluation of temporal water quality changes and an assessment of nonpoint-source pollution.

The monitoring network consists of 145 wells at 80 sites in 25 aquifers. Monitoring wells are equipped with dedicated ground water purging/sampling equipment to provide consistency and efficient collection of highly reliable water samples. Monitoring of water quality includes the examination of general inorganic chemistry, trace metals, cyanide, radionuclides, volatile organic compounds, and pesticides.

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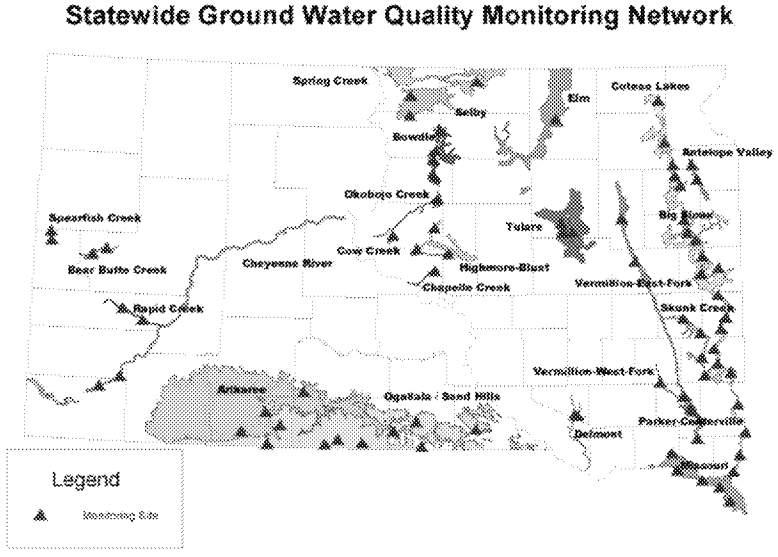
Four criteria were used in the selection of every monitoring site and are as follows.

1. The site must be representative of typical land use over the aquifer.
2. The site must not be near any known or suspected point source of pollution.
3. The site, if possible, should be over a part of the aquifer which is thick enough to accommodate nested wells.
4. The site must be readily accessible to the drilling equipment of the Geological Survey Program and must be reasonably accessible in inclement weather for future sampling.

A map showing the locations of monitoring sites is shown below:



Biological Integrity Monitoring

Biological samples are often included as part of monitoring efforts including use attainability assessments, watershed assessment studies, special projects, etc. Biological indicators can provide a wealth of information regarding the health of an aquatic environment.

Intermittent streams and Perennial Streams: comprise a large majority of stream miles in South Dakota (90%). These streams were once thought to be less significant than perennial streams, but have gained recognition nationwide as being ecologically important. They contribute greatly to downstream water quality, habitat condition and biotic integrity. Since completing the intermittent stream reference site project with SDSU, DENR continues to use these bioassessment tools to make determinations regarding habitat and biotic integrity of potentially impacted streams. Data continues to be collected to add further insight to the biotic integrity of intermittent streams in South Dakota.

DENR and SDSU also identified perennial stream reference sites in the Northern Glaciated Plains (NGP) ecoregion. The project focused on reference site validation, Index of Biological Integrity (IBI) development, and generation of a biomonitoring toolkit. Future work will focus on expanding this reference site network and gaining additional reference site data. Building bioassessment capacity at the statewide level is a long-term goal of DENR and its research partners at SDSU. Currently, DENR focuses biological sampling in streams to the following indicators: fish tissue sampling, aquatic macroinvertebrates, periphyton and mussels. For fish tissue studies, DENR focuses on the occurrence and extent of fish tissue contamination, provide data to support determination of fish advisories (Sections 305(b), 303(d)), and inform additional analysis.

For lakes, DENR focuses biological sampling on aquatic plant/algae surveys, chlorophyll-a testing, and fish tissue samples. For fish tissue, different pollutants may be included as part of the screening process and these can include: mercury, cadmium, selenium, pesticides and PCBs.

Nutrient Impact Studies

Nutrient pollution is considered one of EPA's highest priorities in terms of water quality challenges. EPA and states are working together to increase efforts to address nutrient pollution. DENR's assessment approach identifies waterbodies that exceed regional reference-based nutrient thresholds (for nitrogen and phosphorus) to help in determining support status of some wadable perennial streams and lakes. A variety of indicators are used to inform these analyses including nitrogen and phosphorus levels, Chlorophyll-a concentrations, ecological integrity, habitat assessment, etc. DENR is continuing implementation of this process to identify nutrient-impacted waters in South Dakota via the Integrated Report. For more details see South Dakota's 2016 Integrated Report.

Monitoring to support water quality standards is accomplished through a variety of efforts. The variety of monitoring designs DENR utilizes support water quality standards needs including: site-specific criteria, use attainability determinations. Additionally, the data can be used to

support the transition from fecal coliform to E. coli criteria, the development of nutrient criteria, and the development of biocriteria.

Cooperating Agencies also provide data to support SD DENR assessment decisions, cause and source identification, TMDL development, fish advisories, and beach advisories. (Sections 305(b), 303(d), 319)

III. Monitoring Design

The monitoring designs used by DENR include fixed station sampling, rotating basin, intensive and screening level monitoring. The DENR does not use probabilistic design monitoring because of the design's limitation of not being able to provide data to answer specific questions. While the probabilistic design could answer the question of what the overall water quality in the state is, it fails to address the other four questions the monitoring objectives are attempting to answer. DENR believes sample designs that provide only limited data and a narrow focus are an ill advised use of resources and time. DENR's current sample designs efficiently address the monitoring objectives.

Commented [RL10]: This section really needs updating to reflect the current monitoring program.

Cooperating Agencies

DENR collaborates with a variety of federal and state agencies, local governments, and other monitoring entities to accomplish its monitoring objectives. Major cooperating agencies include: 1) South Dakota Department of Game, Fish & Parks; 2) SD Association of Conservation Districts; 3) USGS; and 4) South Dakota Lakes and Streams Association.

Game, Fish & Parks conducts several monitoring activities that support the DENR's monitoring objectives including sampling of fish flesh and fish surveys. Swimming beach monitoring is described below.

Monitoring of approximately 58 swimming beach areas in the State is conducted weekly during the swimming season from May to September. Water quality samples are collected by the municipality or government agency charged with managing the given waterbody. Following analysis of samples by an approved lab, DENR's Drinking Water Program will close a beach area if fecal bacteria concentrations exceed beach closure standards. DENR provides recent monitoring data and closure information compiled for swimming beaches for reporting in the Integrated Report. This monitoring activity is included as part of the work of cooperating agencies in Table 2.

Commented [RL11]: Is this still accurate?

IV. Core and Supplemental Water Quality Indicators

DENR stream ambient fixed station network monitoring collects extensive water chemistry and pathogen data throughout the state. The following field parameters are collected at all sites at every fixed station visit:

- water temperature, air temperature, dissolved oxygen, pH, water depth, and channel width.

Water samples are collected at all sites for laboratory analysis, and the following core chemical parameters are analyzed:

- alkalinity, conductivity, and hardness;
- total dissolved solids and total suspended solids;
- nutrients (total phosphorous, dissolved phosphorus, ammonia, nitrate-nitrite, and TKN); and
- E. coli.

In addition, several stations are sampled for the following chemical parameters during the irrigation season:

- calcium, magnesium, and sodium.

Stations located along streams that receive flows associated with hard rock mines are also analyzed for:

- total and dissolved metals (cyanide, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.
- Monitoring stations along streams that receive flows from historic uranium mining or current exploration are analyzed for arsenic, barium, molybdenum, uranium, radium 226 and radium 228.

From time to time, the Surface Water Program also conducts intensive water quality monitoring surveys. There may be additional indicators sampled for these studies.

The TMDL/Nonpoint Source Monitoring supplements the fixed station network through collection of core parameters at additional sites within the watershed and/or basin and through collection of supplemental indicators. In addition to the above indicators, this program area may sample for:

- condition of biological communities (macroinvertebrates, periphyton, fish, etc);
- sediment and physical habitat measurements; and
- other toxic pollutants.

SD DENR's lake and reservoir sampling uses a combination of chemical and biological indicators. Core lake/reservoir indicators for lake sampling include:

- field measurements (air temperature, water temperature, dissolved oxygen, pH, and secchi disk visibility);
- chlorophyll *a*;
- nutrients (total phosphorous);
- E. coli.
- Fish tissue

Table 3 summarizes DENR's core and supplement indicators.

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Table 3. Core and Supplemental Indicators

DENR's Core and Supplemental Indicators				
	Aquatic life and Wildlife	Recreation	Drinking Water	Fish/Shellfish Consumption
Core Indicators	• Condition of biological communities	• Pathogens • Chlorophyll *a* • Nutrients	• Pathogens • Nitrates	• Mercury • Selenium • Cadmium

	• Dissolved Oxygen • Temperature • Conductivity • pH • Nutrients • Flow • Habitat assessments • Eutrophic conditions • Landscape conditions	• Landscape conditions • Secchi depth • Flow	• Total dissolved solids • Flow • Landscape conditions	• Chlordane • DDT • PCBs
Supplemental Indicators	• Alkalinity • Chloride • Total residual chlorine • Total suspended solids • Total dissolved solids • Total petroleum hydrocarbons • Oil and grease • Heavy metals other toxic pollutants	• Dissolved oxygen • Heavy metals and other toxic pollutants	• Barium • Chloride • Fluoride • pH • Sulfate • Total petroleum hydrocarbons • Heavy metals and other toxic pollutants	• Other pesticides

V. Quality Assurance and Quality Control

DENR's Quality Management Plan (QMP) was approved by the EPA Region VIII on June 4, 2002. Most programs in DENR have developed their program specific Quality Assurance Project Plans (QAPP). DENR implements the QA activities as defined in the plans. The 319 QAPP is currently being updated, and 319 project quality assurance information is contained in each project implementation plan (PIP). The 106 QAPP is currently being updated and will be submitted to EPA Region VIII when completed. It will also be appended to this document. The state contact is Shannon Mitchell.

Available QA/QC documents include:

- SD. DENR. February 2005. Standard Operating Procedures for Field Samplers, Volume I. Tributary and In-Lake Sampling Techniques.
- SD. DENR. February 2005. Standard Operating Procedures for Field Samplers, Volume II. Biological and Habitat Sampling
- SD DENR. May 1988. 106 Quality Assurance Project Plan for the Surface Water Quality Program.
- SD DENR. February 2001. 319 Quality Assurance Project Plan

Commented [RL13]: Looks like these reference docs may be out of date, need to update this list to reflect the most recent versions. Would suggest including a weblink to them here if possible.

VI. Data Management

DENR manages water quality data in a similar way for the Surface Water Quality Program and the Water Resources Assistance Program. Data is provided electronically to both programs. The data is uploaded to the DENR SQL database where the data is edited and approved. Once the data is approved, the data is uploaded into the EPA WQX system and then ultimately moved to the EPA STORET data warehouse. Fish tissue contaminate data is also stored in the SQL database, and EPA is working with the state to develop a process to upload this data into WQX/STORET in an efficient manner.

Commented [RL14]: Is this still DENR's database?

Commented [RL15]: This statement should be updated or deleted.

With the development of the departments SQL database, DENR staff will only use WQX/STORET as a repository for the state's data. Data retrievals will occur from the state's SQL database

Commented [RL16]: Update.

The National Hydrography Dataset (NHD) was used in the development of the *2006 South Dakota Integrated Water Quality Assessment*

VII. Data Analysis & Assessment

DENR's assessment methodologies are described on pages 27-43 in the *2016 South Dakota Integrated Report for Surface Water Quality Assessment*. Data from the United States Geologic Survey, South Dakota Department of Game, Fish and Parks, conservation districts, water development districts, municipalities, citizen monitoring activities, and the department's own monitoring efforts were used to assess attainment with state surface water quality standards in the *2016 South Dakota Integrated Report for Surface Water Quality Assessment*. These sources are also used in the development of lake survey and watershed assessment reports.

Two major types of assessments were used to determine use support status of waterbodies; one based on monitoring and the other based on qualitative evaluations. Monitoring data were primarily obtained from South Dakota DENR, United States Geological Survey (USGS), the Lac Qui Parle –Yellow Bank Clean Water Partnership, the city of Watertown, the city of Sioux Falls, and the city of Brookings. Sources of quantitative and qualitative lake assessment data was acquired from the Statewide Lakes Assessment project and individual assessment studies.

Commented [RL17]: Should this be included here and is the list still accurate?

DENR continues to monitor for potential impacts from nutrients, and continue to refine an assessment approach for nutrient impacts. This assessment approach identifies waterbodies that exceed regional reference-based nutrient thresholds (for nitrogen and phosphorus) to help in determining support status of some wadable perennial streams and lakes. A variety of indicators are used to inform these analyses including nitrogen and phosphorus levels, Chlorophyll-a concentrations, ecological integrity, habitat assessment, etc. This process will continue to be refined as more monitoring data is made available. For more information on DENR's nutrient impact studies see pages 30-40 of 2016 Integrated Report.

DENR maintains a Quality Assurance/Quality Control (QA/QC) Program to ensure that all environmental water quality data generated or processed meets standard accepted requirements for precision, accuracy, completeness, representativeness, and comparability. This entails the preparation and periodic review and revision of the DENR Quality Assurance Program and

individual project plans. It also includes the preparation of periodic reports to DENR management and EPA; the review of contracts, grants, agreements, etc., for consistency with QA/QC requirements; and the administration of QA/QC systems and performance audits. The latter activity requires the establishment of schedules for the collection of the duplicate and blank samples, periodic testing of field sampling techniques, and liaison with contracted labs to ensure compliance with QA/QC objectives. In 1998, the Water Resources Assistance Program created a QA/QC document and protocol for its Clean Lakes and NPS programs. An updated Standard Operating Procedure manual was completed and published in June 2003.

Commented [RL18]: Update this statement.

The ambient monitoring network provides useful information on overall stream water quality. Only a brief summary of water quality is included because of the large volume of data and reports. A more detailed description of the stream ambient monitoring program is found in the preceding Monitoring Design section of this document.

Fixed station monitoring data are assessed by dividing major streams into segments that contain the same or similar designated beneficial uses, water quality standards criteria, and environmental and physical influences. Data obtained during the current reporting period are analyzed by utilizing the EPA WQX/STORET data systems. The data for each monitored segment were compared to state water quality standards applicable to the beneficial uses assigned to the segment in question (Tables 2 and 3).

Monitored stream course mileages and lake acreages were measured using EPA Reach Indexing Tool software. All nonsupporting stream segments for which the data were available are also listed as requiring TMDLs.

Specific criteria were developed to define how data for streams would be evaluated to determine the status of each stream segment (waterbody). The following criteria were used:

Waterbodies were also considered nonsupporting if beach closures were attributable to pollution-related causes. Waterbodies were listed as nonsupporting through beach closures where there were more than three beach closures per season in a consecutive three-week sampling period based on fecal coliform concentrations.

Deviations from the above criteria were allowed in specific cases, and are generally discussed in the proceeding tables listing the surface water quality summaries. Use support assessment for all assigned uses was based on the number of violations of water quality standards for the following parameters: total suspended solids, total dissolved solids, pH, water temperature, dissolved oxygen, fecal coliform (May 1 - September 30), and others. Violations of more than one parameter were not considered additive in determining overall use-support status for any given waterbody. A stream segment with only a slight exceedance (< 10% violations for one or more parameters) is considered fully supporting. Complete listings of relevant parameters appear in Tables 2 and 3. South Dakota has established the following general criteria for determining use support of monitored streams:

Table XX: Criteria for Determining Support Status (Table 8 from 2016 Integrated Report)

Description	Minimum Sample Size	Impairment Determination Approach
FOR CONVENTIONAL PARAMETERS (such as dissolved oxygen, TSS, fecal coliform bacteria, *E. coli* bacteria, pH, water temperature, etc.)	STREAMS: a minimum of 10 samples for any one parameter are required within a waterbody reach. A minimum of two chronic (calculated) results are required for chronic criteria (30-day averages and geomeans). LAKES: at least two independent years of sample data and at least two sampling events per year.	STREAMS: >10% exceedance for daily maximum criteria (or 3 or more exceedances between 10 and 19 samples) or >10% exceedance for chronic criteria (or 2 or more exceedances between 2 and 19 samples) LAKES: >10% exceedance when 20 or more samples were available. If < 20 samples were available, 3 exceedances were considered impaired. See lakes listing methodology section for specifics on parameters associated with a vertical profile (i.e., dissolved oxygen, water temperature, pH, and specific conductance).
FOR TOXIC PARAMETERS (such as metals, total ammonia, etc.)	All Lakes and Streams: Minimum of 2 samples within a consecutive 3 year period within the data age date range.	All Lakes and Streams: More than one exceedance of toxic criteria within a consecutive 3 year period (within the data age date range) for the acute and/or chronic standard.
FOR MERCURY IN FISH TISSUE	ALL Lakes and Streams: A minimum of 10 samples are required. All available data from January 2006 through September 2015 was used.	ALL Lakes and Streams: 95th percentile of data exceeds 0.3mg/kg mercury OR when a fish consumption advisory has been issued.
DATA AGE (for both conventional and toxic parameters)	STREAMS: Data collected from October 1, 2010, to September 30, 2015. LAKES: All available data collected from January 2006 through September 2015. Although the reporting cycle spans two years, that data age does not allow for sufficient temporal variability. Therefore, the above data ages will be used unless there is justification that the data are not representative of current conditions.	

~~For Conventional Parameters (such as TSS, DO, pH, water temperature, etc.)~~
~~Fully supporting <1 - 10% of values violate acute water quality standards~~

~~Not supporting >10% of values violate acute water quality standards~~

~~For Toxic Parameters (such as metals, total ammonia, etc)~~

~~Fully supporting — ≤ 1 violation of the acute water quality standard within the past three years or fish flesh sampling events that do not contain levels greater than FDA's action level~~

~~Not supporting — >1 violation of the acute water quality standards within the past three years or one fish flesh sampling event that contains levels greater than FDA's action level (such as 1 ppm for mercury)~~

Commented [RL19]: Suggest deleting these, as non-support determinations are covered in the above table.

In order to ensure a sufficient number of samples was available for each stream segment (usually a minimum of 20) to arrive at an assessment that would be statistically acceptable, the period of record considered for flowing waters is 5 years, and for lakes is 10 years.

Commented [RL20]: Changed this from a set date range in time to reflect overall period of time considered in data assessments.

In addition to the use support assessment above, South Dakota has chosen to use the assessment categories that EPA recommends in its guidance that was issued on July 21, 2003. South Dakota's assessment categories are as follows:

Category 1: All designated uses are met;

Category 2: Some of the designated uses are met but there is insufficient data to determine if remaining designated uses are met;

Category 3: Insufficient data to determine whether any designated uses are met;

Category 4A: Water is impaired but has an EPA approved TMDL;

Category 4B: Water is impaired but implementation project (best management practices) is in place;

Category 4C: Water is impaired by a parameter that is not considered a "pollutant";

Category 5: Water is impaired or threatened and a TMDL is needed;

~~Category 6A: Water is not impaired but requires a review of an approved point source TMDL in order to maintain water quality standards; and~~

~~Category 6B: Water has an existing point source TMDL approval, which does not require a review.~~

Commented [RL21]: Don't see these referenced in the 2016 IR, suggest deleting if DENR doesn't use them.

Support assessment for fishable (fish and aquatic life propagation) use primarily involved monitoring the following major parameters: dissolved oxygen, total ammonia, water temperature, pH, and total suspended solids.

Support assessment for swimmable use (immersion recreation and limited contact recreation) involved monitoring E.coli and dissolved oxygen from May 1 through September 30 of each year (Table 2).

South Dakota adopted numeric surface water quality criteria with the 1967 "Water Quality Standards for the Surface Waters for the State of South Dakota". The main intent of numeric water quality criteria is to regulate discharges of wastewater from industries and municipal wastewater treatment facilities. Numeric criteria are needed to develop numeric effluent limits for facilities that discharge wastes to surface water. However, since South Dakota has numeric water quality criteria, a strict interpretation of the water quality standards could imply that a waterbody could potentially be listed as "impaired" or "nonsupporting" even if only one violation occurred within a five year period. South Dakota has traditionally viewed the 10% approach (as stated in the criteria for determining support status in Table 6) as an appropriate measuring tool to determine waters that require further in-depth study and TMDL development.

Factors such as drought, high precipitation events, and other environmental factors can cause significant variation in water quality. One violation of a conventional parameter, such as pH or water temperature, does not indicate a water body is not supporting its beneficial use. The methodology employed by the department in the interpretation of the data for the 2006 Integrated Report is consistent with DENR's interpretation of the South Dakota Surface Water Quality Standards. Therefore, for the Integrated Report purposes, DENR defines "impairment" or "nonsupport" of a beneficial use of a water body by the criteria found in Table 6.

Lake water quality data was acquired from the DENR's Statewide Lakes Assessment (SWLA) project. Lakes are sampled on a four year rotation (i.e. about 31 lakes annually) twice during the growing season, at one to three predetermined site locations. The number of site locations assigned to each lake was dependent on basin size. Field measurements were collected and water samples were composited from each site. Lake data was available from 1989 through the 2005 sampling seasons.

Data collected during the growing season from individual lake assessment projects was also used to supplement the SWLA data. Project specific data was usually collected monthly throughout the growing season (May 15 - September 15) from site locations consistent with those established during the SWLA project. Field measurements and water samples were usually collected at each site. Additional chlorophyll-a data was also acquired from citizens monitoring efforts.

A group of 17 standard water quality parameters were measured or analyzed. Water temperature, dissolved oxygen, conductivity, specific conductance, pH and Secchi disk transparency were measured on site. Chlorophyll-a was extracted from 50-1000 ml of lake sample and analyzed by spectrophotometer as described by APHA (1995). The remaining samples were preserved, iced and shipped to the State Health Laboratory in Pierre, South Dakota for individual parameter analysis.

For the 2006 reporting cycle, support status of lakes and reservoirs was evaluated based on trophic state indicators and water quality standard limits. The Trophic State Index (TSI) approach (Carlson 1977), represents an impairment targeting criteria, designed to augment narrative criteria for making lake support determinations. All available Secchi transparency and chlorophyll-a data from 1989-2005 was used to calculate the median TSI value for each lake based on a minimum of two years data.

The fishery beneficial use designation was used as a classification tool to define the support status of lakes. This approach differs from the ecoregion approach used in previous reporting cycles (Stueven et al. 2000). A document explaining the rationale and methodology of the current TSI approach for Targeting Impaired Lakes in South Dakota is located on the DENR website at:

[HYPERLINK "http://www.state.sd.us/denr/DFTA/WatershedProtection/WQInfo.htm" \l "Information"].

Use support (full and non-support) determinations based on the median Secchi-chlorophyll-a TSI were derived from statistical analysis and Best Professional Judgment (BPJ). TSI values are based on a median of all available data and not individual data values. If the median TSI value exceeded the support criteria in Table 7, the waterbody was listed as non-supporting the fishery beneficial use.

Commented [RL22]: I'm thinking this Lakes section needs to be revamped and possibly replaced by assessment language from the 2016 IR. If you agree, I can take a stab at it.

Table [SEQ Table * ARABIC]: South Dakota Fishery Beneficial Use Support Determination Range For Lakes

Ecoregion Support Determination		
TSI Range		
Beneficial Use	Fully Supporting	Not Supporting
Coldwater Permanent Fish Life Propagation	≤ 48.4	≥ 48.5
Coldwater Marginal Fish Life Propagation	≤ 53.4	≥ 53.5
Warmwater Permanent Fish Life Propagation	≤ 58.4	≥ 58.5
Warmwater Semi-Permanent Fish Life Propagation	≤ 63.4	≥ 63.5
Warmwater Marginal Fish Life Propagation	≤ 68.4	≥ 68.5

Commented [RL23]: Should this TSI table still be in the strategy?

In addition to the TSI values, lake support status was evaluated using state water quality standards. State water quality standard numeric limits provide a benchmark for making listing decisions. However, water quality is variable and dependent on the environmental conditions present during sample collection. To account for variability, all available surface data collected during the growing season from 1989-2005 was used to identify parameter specific impairments for individual assessed lakes.
Lakes were listed based on the following criteria.

- 10% surface exceedances, based on ≥ 20 sample points; or
- 25% surface exceedances, based on < 20 sample points.

Profile data was used to make final listing determinations for parameters (temperature, pH and dissolved oxygen) specific to the fish life propagation beneficial use. Fish and other aquatic life are relatively mobile and can move vertically within the water column to escape adverse conditions. When 10% or 25% surface violations were observed for temperature, dissolved oxygen or pH; profile data was used to evaluate whether violations also occur throughout the water column. Lakes were considered fully supporting the aquatic life beneficial use, if profile data indicate a region within the water column where temperature, pH, and dissolved oxygen were meeting numeric water quality standards.

Parameters such as nitrate, ammonia-nitrogen (as N), specific conductance, total dissolved solids, total suspended solids and alkalinity not collected in the profile were listed based on the criteria found in Table 6 depending on the number of data available for a given lake.

Waterbodies were also evaluated based on beach closures, fish kills, and fish consumption advisories. Beach closure information collected during this reporting period (2004-2005) was used to make impairment decisions (Table 32). Lakes were listed if three beach closures per season occurred in a consecutive three-week sampling period. A public beach is recommended for closure if the following fecal coliform levels are not met.

(1) Any three consecutive samples exceed 200 fecal coliform per 100 milliliters;

(2) Any two consecutive samples exceed 300 fecal coliform per 100 milliliters; or

(3) Any single sample exceeds 1,000 fecal coliform per 100 milliliters.

Long-term trends in TSI were estimated from data collected during the 1989 through 2005 statewide lake assessments and from individual assessment projects. A slope of ± five units between respective TSI values was selected as signifying a legitimate change in lake water quality over the course of data availability. Long-term trends covering the period from 1989 through 2005 are summarized in the Lake Water Quality Assessment chapter of this section (Table 16).

As mentioned above, DENR continues to implement an assessment approach for determining nutrient impacts to water resources.

VIII. Reporting

The DENR submitted, and EPA approved, the *2016 South Dakota Integrated Report For Surface Water Quality Assessment*. DENR will continue to submit the bi-annual Integrated Report to provide EPA and the public with the latest water quality information for South Dakota. The integrated report is accessible from the state's web site at [HYPERLINK "http://www.state.sd.us/denr/Documents/04IRFinal.pdf"].

DENR also publishes lake survey and watershed assessment reports. These can be accessed on-line at [HYPERLINK "http://www.state.sd.us/denr/document.htm" \l "Watershed%20Protection"].

IX. Program Evaluation

The department continually evaluates its monitoring program to determine if the monitoring is meeting the objectives and the needs of affected programs. This continued feedback is flexible and proactive, and changes can be implemented quickly.

The department also has a Continuing Planning Process (CPP) document. The CPP is a plan that each state must develop and maintain as required by Section 303(e) of the Clean Water Act. South Dakota's CPP describes processes used to manage the state's water quality programs and the relationship between these activities by addressing each of the minimum nine federal CPP elements required under the Clean Water Act. The CPP is accessible from the state's web site at [HYPERLINK "http://www.state.sd.us/denr/Documents/ContPlanProcess04.pdf"].

Commented [RL24]: Broken link, please update.

X. General Support and Infrastructure Planning

Future resource needs are identified above in Section XX. Monitoring Designs. The budget and staffing for monitoring, training, data assessment, data management, and reporting activities is determined by the legislature annually. As funding resources become available, such as supplemental 106 federal funds, DENR will evaluate the current budgetary and staffing authority available before pursuing additional funds. If additional monitoring and reporting are required by federal or state statute or rule, current monitoring efforts and new requirements will have to be prioritized and curtailed or eliminated.

Laboratory services are currently provided by both the state Department of Health Laboratory and private laboratories. Laboratory staffing and training are handled by the individual laboratories. If DENR needs are not addressed by these laboratories, another laboratory that meets DENR's requirements is contracted.

Reference:

The 2016 SDDENR Integrated Report can be found here: [HYPERLINK "http://denr.sd.gov/des/sw/IntegratedReports.aspx"]

Appendix A

Ambient Water Quality Monitoring Station List,
Site Location Map, and Lake Sampling Schedule for 2004-2008